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AN

APPENDIX

To the *Engliſh* Tranſlation of

COMMANDINE's EUCLID;

WHEREIN

The Eleventh and Twelfth Books of the ELEMENTS are made eaſy to the meaneſt Capacity, by exhibiting the Solids themſelves to the Eye, inſtead of their ſeveral Pictures or Projections laid down by the ſeveral Writers of Elements of Geometry.

A TRACT uſeful and neceſſary for Painters, Builders, Gardeners, and all Perſons who would inform themſelves demonſtratively in Perſpective, Menſuration, Sphericks, *&c.* or qualify themſelves to read the Works of thoſe who have written farther on ſolid Geometry.

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WITH AN

INTRODUCTION,

Explaining the Projection uſed by the Ancients, and ſhewing its Excellency to any other for this Purpoſe.

By *SAMUEL CUNN.*

LONDON:
Printed for THO. WOODWARD, at the *Half Moon*, over againſt St. *Dunſtan*'s Church, in *Fleetſtreet.*
MDCC XXV.

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THE INTRODUCTION.

THE ancient Geometricians, in order to teach their Scholars thoſe Parts of the Elements which treated of Lines and Planes inclined to each other, and of Solids, and their external and internal Parts, uſed a Perſpective or Projection, to exhibit to the Eye the Figures they had imagined.

But they chuſed the moſt ſimple, the leaſt confuſed, and moſt eaſiy apprehended.

They imagined the Eye of the Projection or Picture ſo far removed from it, that the Lines drawn from it to the Picture might make Angles with one another leſs than any right lined Angle aſſignable; ſo that they might be conſidered as Parallels; and always conſidered their Poſition ſo, that they ſhou'd not coincide with any of thoſe Lines they deſigned to project, nor any two projected Points coincide.

From whence flow (as ſo many Corollaries) the following Properties and Conveniencies; well worth the Notice of thoſe who deſign to read the ſolid Geometry of the Ancients.

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1. All parallel Lines are repreſented by Parallels in the Projection, whether they are parallel to the Plane of the Projection, or any how ſtanding on it.
2. All equal Parallels are repreſented by equal Parallels in the Projection.
3. All Parallelograms are repreſented by Parallelograms in the Projection.
4. Of every Set of Parallels, the Lines in the Projection have to each other the ſame Proportion they had in the imagined Figure
5. All ſimilar Plane Figures, of what Kind ſoever, whoſe Planes are parallel, or are in the ſame Plane, are repreſented by ſimilar Plane Figures. And if theſe Plane Figures are equal, their Repreſentation will be ſo likewiſe.
6. All Circles whoſe Planes are parallel to the Plane of Projection, are repreſented by Circles.
7. All Circles whoſe Planes are inclined to the Plane of Projection, are repreſented by Ellipſes; unleſs the Plane of Projection form the Sub-contrary Section, in which Caſe it will be a Circle.
8. All Spheres are repreſented by Ellipſes; unleſs the Lines from the Eye be perpendicular to the Plane of Projection; in which Caſe they are repreſented by Circles.
9. All ſimilar Solids ſimilarly poſited in Reſpect of the Plane of Projection, are repreſented by ſimilar plain Figures ſimilarly poſited. And if ſuch Solids be equal, the plain Figures will be equal alſo.
10. Every Parallelepipedon is repreſented by joining the correſpondent Angles of the two Parallelograms, which repreſent any two of its oppoſite Faces.
11. Every Priſm is repreſented by joining the correſpondent Angles of the Figures repreſenting the parallel Planes.
12. Every Pyramid is repreſented by drawing Lines from the Point, repreſenting the Vertex to the Angles of the Figure repreſenting the Baſe.
13. Every Cylinder is repreſented by drawing two parallel Lines, each of which touch the Figures repreſenting the Baſes.
14. Every Cone is repreſented by two Lines drawn from the Point repreſenting the Vertex, to touch the Figure repreſenting the Baſe.

15. The Converſe of theſe Properties are nó where univerſally true: For the ſame Projection may repreſent different Figures. In all Projections where the Lines from the Eye are inclined to each other, the preceding Properties are true only in particular Caſes.

And in the Projection called Orthographick, tho' the Lines from the Eye are parallel to one another, yet it is unfit for this Purpoſe; becauſe every Line perpendicular to the Plane is projected into one Point; and every perpendicular Plane, and all the Lines in that Plane, are confounded in one right Line in the Projection.

This Projection is the ſame with that made by the Shadow of any Figure expoſed to the Sun. Therefore, if any one will erect with Wires the ſolid Schemes in the Elements, and expoſe them to the Sun, they will find the Shadows exactly with the plane Schemes which repreſent thoſe Solids.

From what hath been ſaid, it appears, that of all Projections, this is the moſt ſimple, moſt eaſy, and moſt natural. Nevertheleſs, it is attended with ſome Difficulties often complained of by Beginners.

For tho' the projected Lines have a great Affinity to thoſe they repreſent, (and very often may be exactly equal to them,) yet the Angles (excepting thoſe whoſe Planes are parallel to the Projection) are every where enlarged or diminiſhed. Sometimes a right Angle is repreſented by an acute one, ſometimes by an obtuſe one, and ſometimes by two right Lines meeting one another directly. A Square for the moſt part is repreſented by a Rhombus, and a Rectangle by a Rhomboides. And indeed, in every Scheme the Angles are diſſimilar to thoſe they repreſent.

The ſame Projection may repreſent Figures varying from what it is deſigned to repreſent, and this too in numberleſs Ways. And the Repreſentatives of Planes and Solids falling on thoſe of other Planes and Solids, ſo confound and diſhearten ſo many Beginners, that they paſs by the Demonſtrations, and content themſelves with the bare Text of the Propoſition; which is a Fault ſcarce to be pardon'd don'd in any who propoſe to acquaint themſelves with that moſt uſeful Knowledge, Geometry. Nay, I have met with thoſe who have not been able to exhibit to the Eyes of thoſe they undertook to teach, the Figures of ſome of the Propoſitions of the eleventh Book of the Elements.

To remedy this Inconvenience, ſome have cut out in Wood the Solids, in order to help the Imagination: But then the internal Parts are hidden from the Eye, and the back Parts cannot be ſeen at the ſame Time that the fore Parts are. To cure this Inconvenience, I have cauſed Threads and Wires to be raiſed on Boards, with Letters glewed on to the particular Angles, and thereby have ſhewn the ſeveral Propoſitions of the Solids. But this, as well as the former, is of too great an Expence for ſome who have Inclinations, tho' not Time enough, to ſtudy this uſeful Part of Geometry, by a Contemplation of the Projections. And yet, without this Knowledge, it is almoſt impoſſible for a Man to underſtand the modern Perſpective uſed by Painters, Builders, Gardeners, Deſigners, *&c.* and to give a Demonſtration of their Works: Which is the principal Cauſe why we ſcarce meet with any Piece of perſpective Draught without geometrical Faults.

In order to make this Part of the Science eaſy, Mr. *John Dee*, in his Verſion of the Elements of *Euclid*, hath contrived Schemes to be paſted and raiſed up, to ſhew to the Eye the Planes repreſented in the Projection of ſome of the Propoſitions; and in others hath taught (tho' obſcurely enough) how to draw Schemes on a plane Paſtboard, and how to lap them up, in order to repreſent the Solids treated of.

This latter Sort ſtruggles with the ſame Difficulty that thoſe cut in Wood doth; and of the former he hath managed but few, and them ſome of the more eaſy Propoſitions, leaving out thoſe which moſt wanted Illuſtration; and of theſe too, ſome of them uncouthly.

From theſe Conſiderations, I have paſted Papers to be raiſed up to every one of the Propoſitions of the eleventh and twelfth Books, fitted for the *Engliſh* Verſion of *Commandine*'s *mandine*'s *Euclid* : From whence the Solids will be exhibited to the Eye, their fore and back Parts together, with the Lines and Planes in their inner Parts, and all by Inſpection; whereby the moſt difficult Propoſitions will become eaſy, and the Student's Time ſhortened. And if as he goes, he compares theſe Schemes with thoſe projected, he will not only gain the Demonſtrations in theſe two Books, but alſo a familiar Acquaintance with the Schemes uſed by Geometricians to repreſent Solids and Planes interſecting one another, and thereby become capable to contemplate with Eaſe and Pleaſure their Schemes in other Books.

Books Sold by Thomas Woodward, *at the* Half Moon, *over againſt St.* Dunſtan's *Church, in* Fleetſtreet.

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BOOK XI.

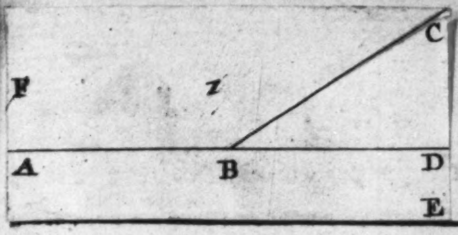
PROP. I. Raiſe up the Plane CBD, and the Propoſition will be clear.

PROP. II. Raiſe up the Plane GEFH, and all is evident.

PROP. III. Raiſe up the Plane CB.

PROP. IV. Raiſe up the Planes AFD, CFB, till F coincides with F; and from F imagine a perpendicular drawn to E, or ſtick a Pin upright in E.

PROP. V. Raiſe the Plane ABF till AB is perpendicular to BD, and then the Demonſtration will be clear.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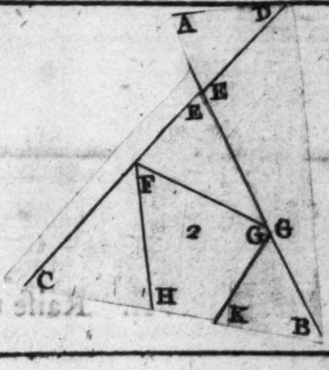
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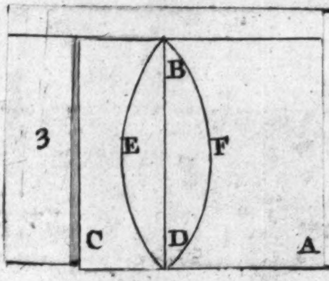
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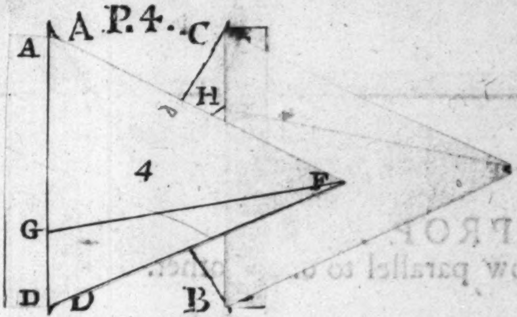
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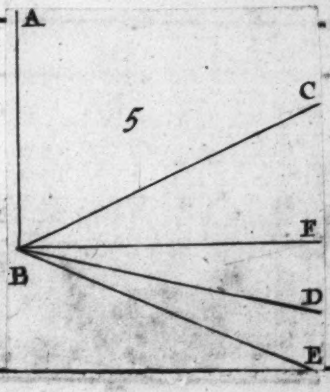
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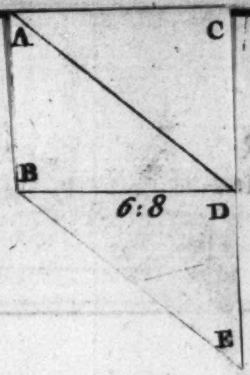
PROP. VI. and VIII. Raiſe the Plane AD, till the Lines AB, CD, are both perpendicular to the Plane BE.

PROP. VII. Raiſe the Plane EGF any how.

PROP. IX. Raiſe the Planes AF, CF, till EGF coincides with EGF.

PROP. X. Raiſe up the Planes ABC, DEF, any how parallel to one another.

PROP. XI. Raiſe up the Plane AFD perpendicular to the Plane GC.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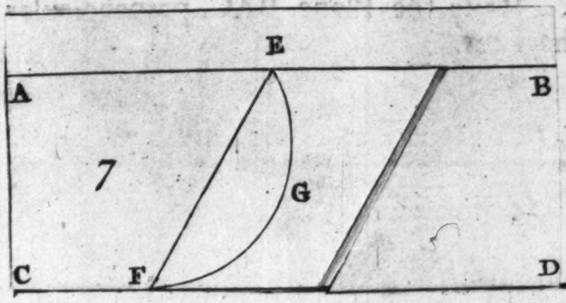
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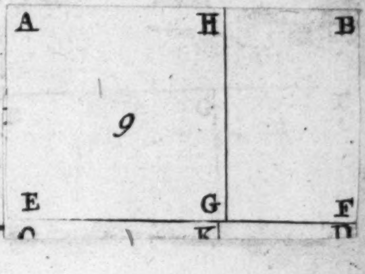
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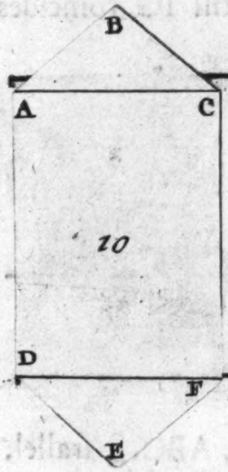
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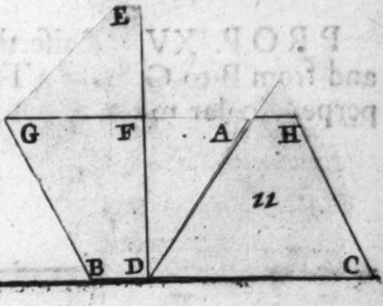
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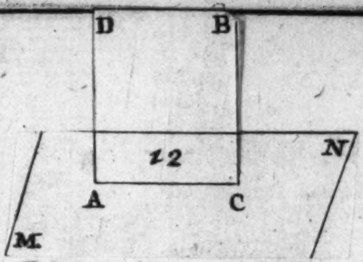
PROP. XII. Raiſe up the Plane DC till AD is perpendicular to the Plane MN.

PROP. XIII. Raiſe the Plane BAC perpendicular to the Plane of the Leaf.

PROP. XIV. Raiſe up the Planes CD, EF, parallel to one another, and perpendicular to the Plane AE; and in the Lines CA, BF, bend the Planes till IG coincides with IG at K.

PROP. XV. Raiſe the Planes DEP, ABC, parallel, and from B to G draw a Thread, or ſuppoſe a Line drawn perpendicular to the Plane DEF.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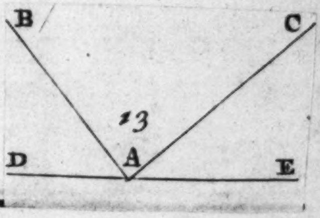
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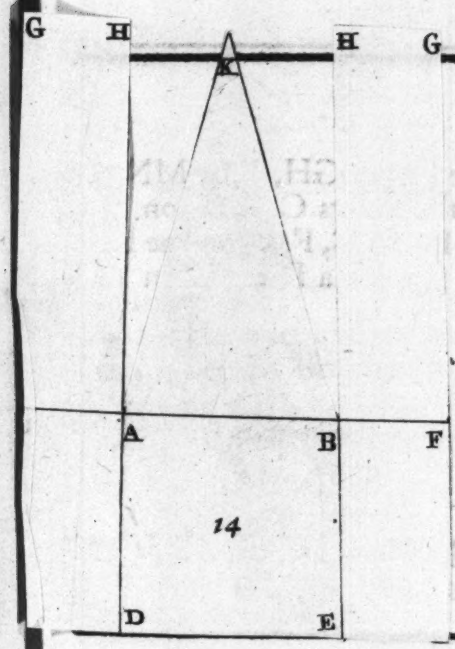
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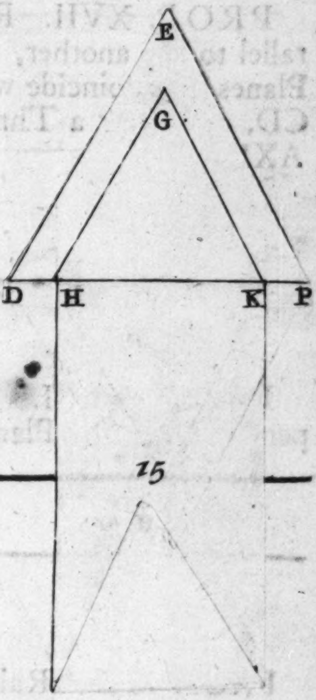
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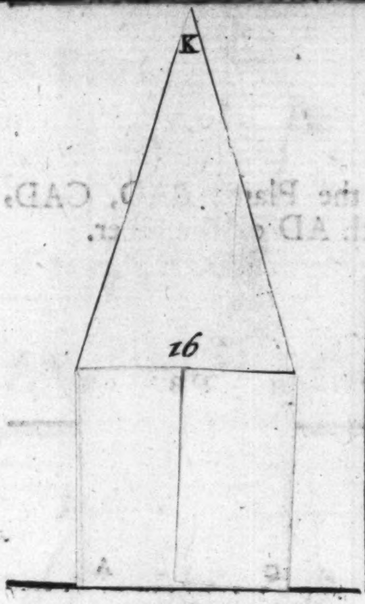
PROP. XVI. Raiſe the Planes AB, HD, any how parallel to one another.

PROP. XVII. Raiſe the Planes GH, KL, MN, parallel to one another, ſo that the Points C, F, D, on theſe Planes may coincide with the Points C, F, D, on the Plane CD, and draw a Thread, or ſuppoſe a Line drawn thro' AXD.

PROP. XVIII. Raiſe the Plane DE till AB is perpendicular to the Plane of the Leaf.

PROP. XIX. Raiſe the Planes AB, CB, till they are both perpendicular, to the Plane ADC, and the Line BD in one coincides with the Line BD in the other.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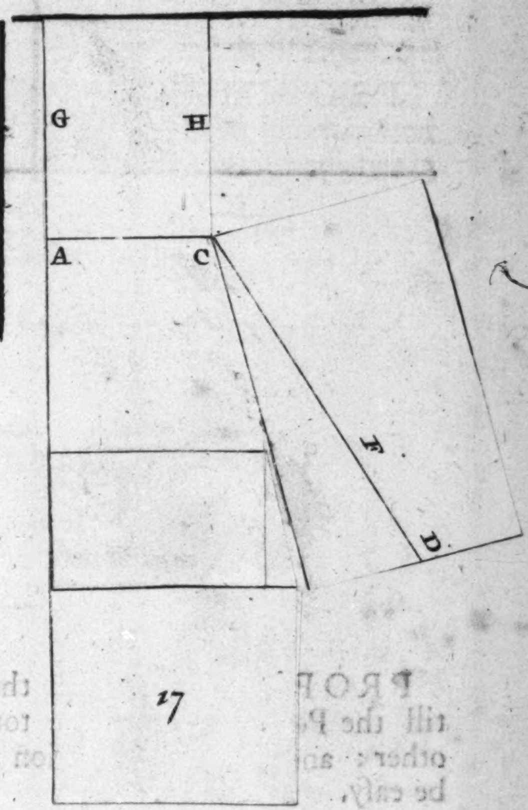
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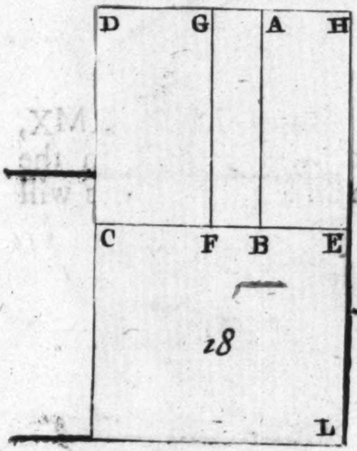
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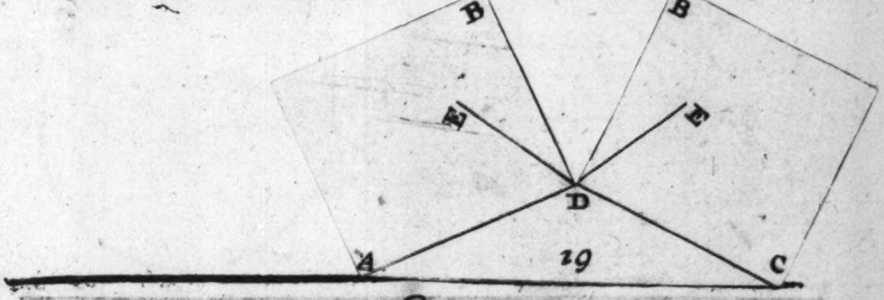
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PROP. XX, XXI. Raiſe the Planes BAD, CAD, till AD of the one coincides with AD of the other.

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PROP. XXIII. Raiſe the Planes LNR, RMX, till the Point L of the one touches the Point L in the other; and the Demonſtration in all the three Caſes will be eaſy.

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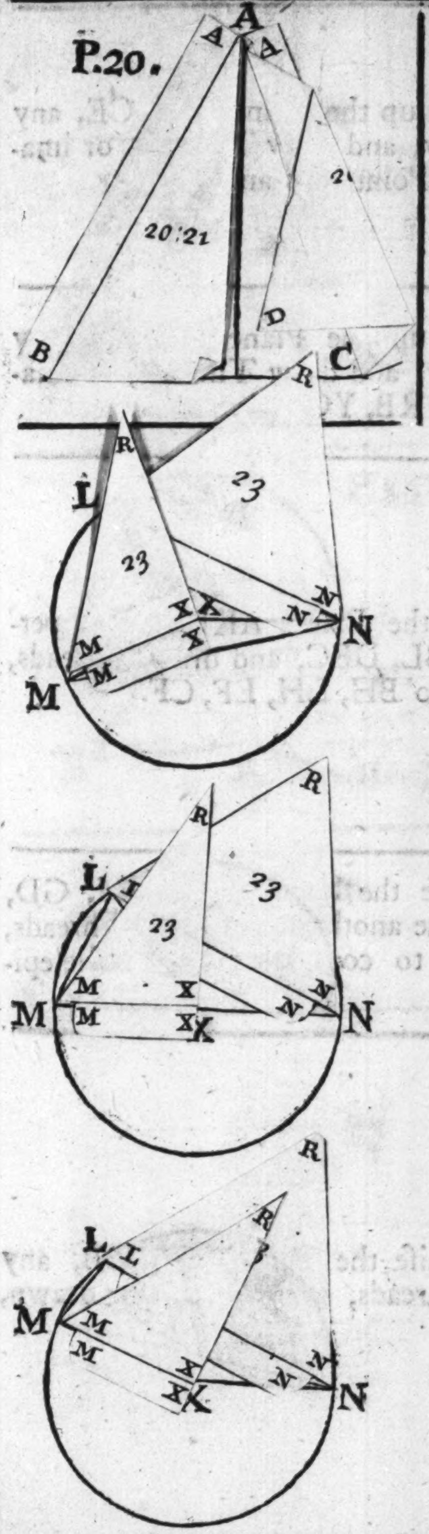
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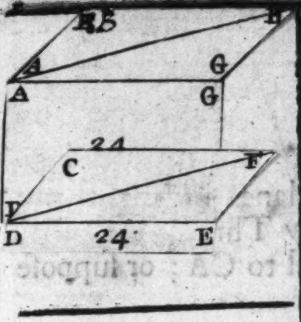
PROP. XXIV. Raiſe up the Planes AH, CE, any how parallel to one another, and draw Threads, or imagine Lines drawn thro' the Points CB and FH.

PROP. XXV. Raiſe up the Planes ΨS, ΞN, any how parallel to one another, and draw Threads, or imagine Lines drawn thro' ΨΞ, RB, YG, &c.

PROP. XXVI. Raiſe the Planes AKH, DGF perpendicular to the Planes ABL, DEC, and draw Threads, or ſuppoſe Lines drawn thro' BH, LH, EF, CF.

PROP. XXVII. Raiſe the Planes KL, AM, GD, FE, any how parallel to one another, and draw Threads, or ſuppoſe Lines drawn to compleat the Parallelepipedon.

PROP. XXVIII. Raiſe the Planes AH, GB, any how parallel, and draw Threads, or imagine Lines drawn thro' DC, HB.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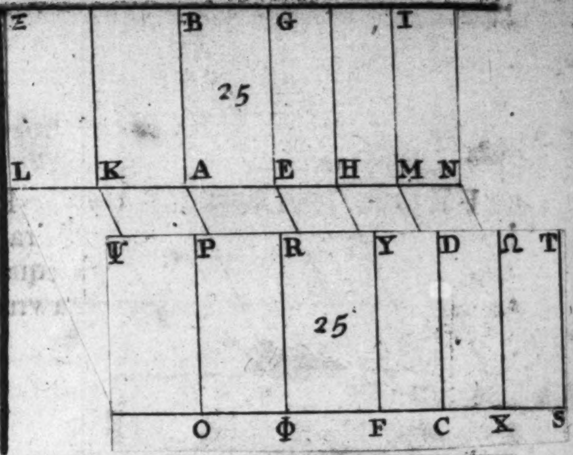
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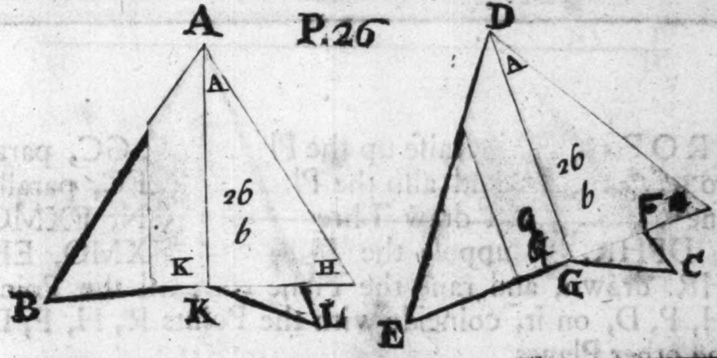
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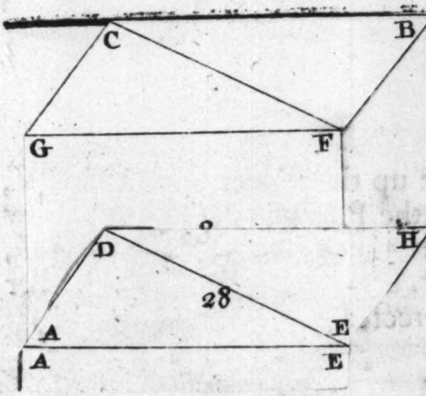
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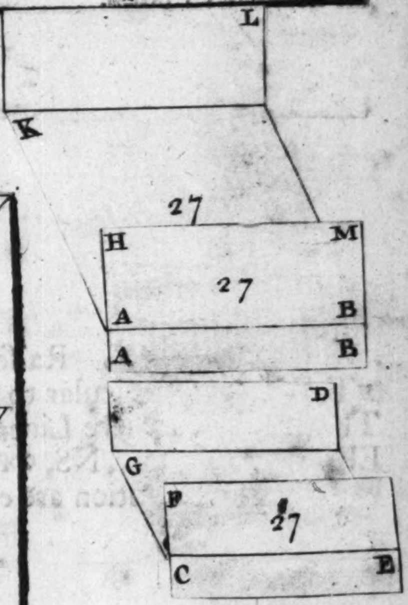
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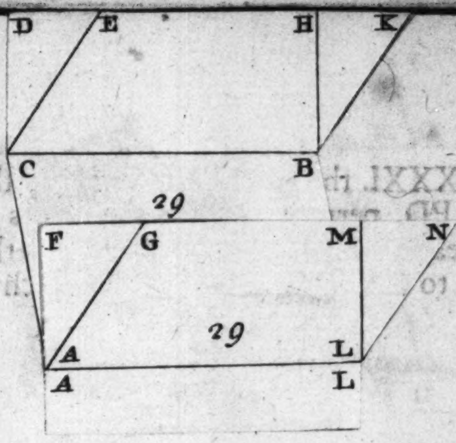
PROP. XXIX. Raiſe up the Planes DB, GL, any how parallel to one another, and draw Threads thro' FD, EG, MH, KN, each of Length equal to CA; or ſuppoſe the Lines FD, EG, MH, KN, drawn.

PROP. XXX. Raiſe up the Planes NB, GC, parallel to one another, and alſo the Planes MB, FC, parallel to one another, and draw Threads thro' GN, FXMO, EK, DPHR, or ſuppoſe the Lines GN, FXMO, EK, DPHR. drawn, and raiſe the Plane RC, till the Points R, H, P, D, on it, coincide with the Points R, H, P, D, on the other Planes.

PROP. XXXI. Raiſe up the Planes GH, MB, PV, ΞT, ZX, perpendicular to the Planes AB, OX, and draw Threads, or conceive Lines drawn thro' the Points MG, EK, ΞP, ZSF, ΓΨI, NS, ΦΨ, and the Figures to the former Part of the Propoſition are erected.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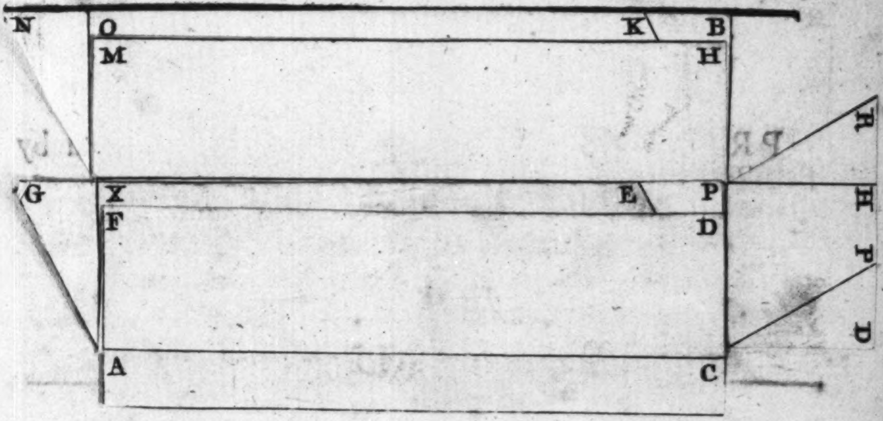
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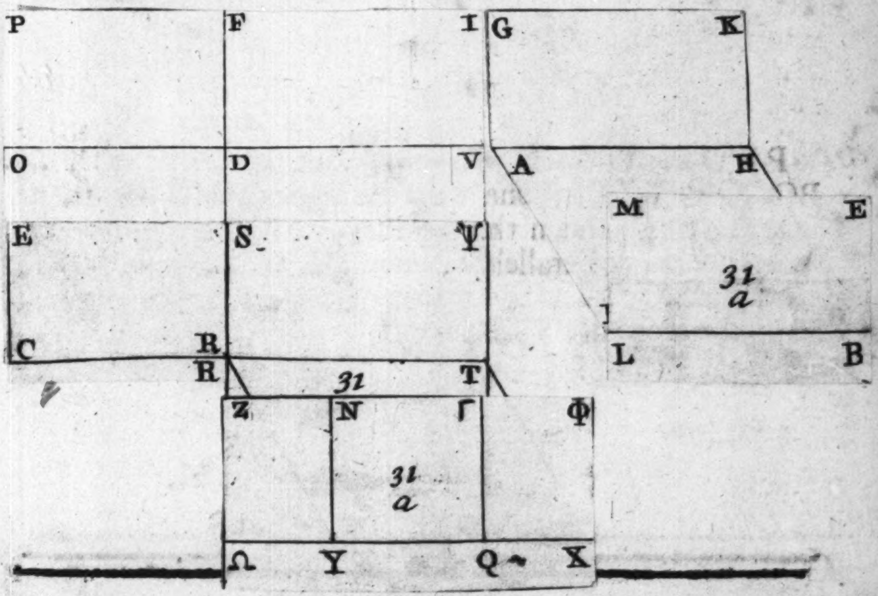
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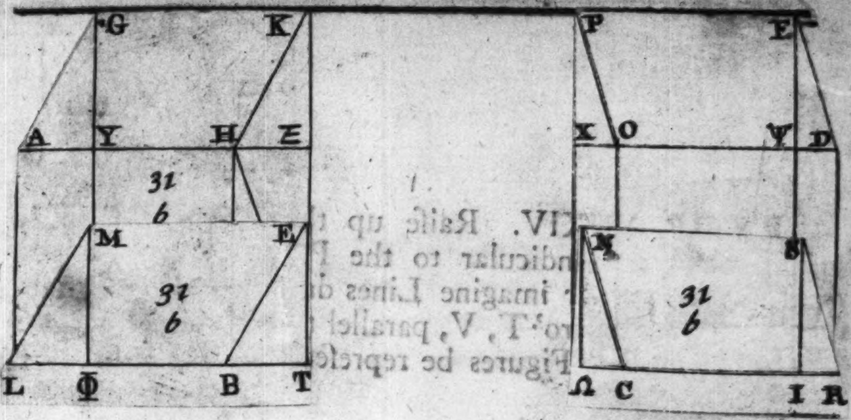
PROP. XXXI. the latter Part. Raiſe up the Planes MT, GH, NR, PD, perpendicular to the Planes AT, XR, and draw Threads, or imagine Lines drawn, thro' MG, EK, each equal to LA; and thro' NP, SF, each equal to ΩX.

PROP. XXXII. Raiſe up the four Planes, and by five Threads compleat the Parallelepipedons.

PROP. XXXIII. Raiſe up the Planes C, FD, A, BO, K, parallel to one another, and draw Threads, or imagine Lines drawn thro' the Points R, F, H, E, O, &c. to compleat the Parallelepipedon CD, AB, EX, LP, OK.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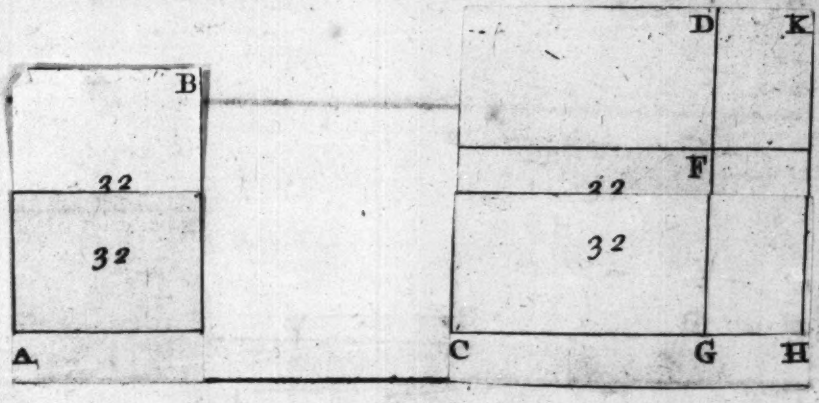
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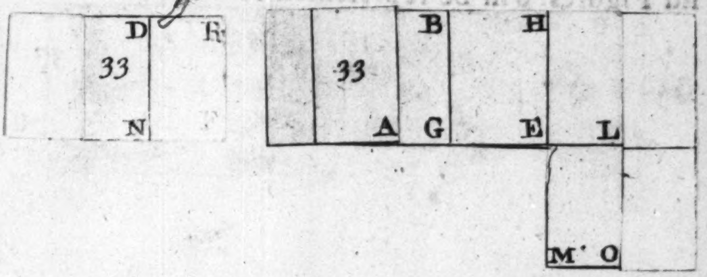
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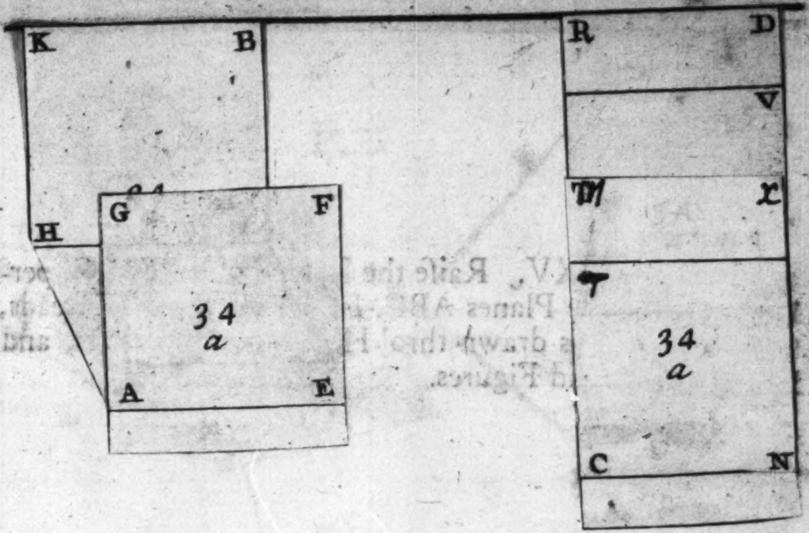
PROP. XXXIV. Raiſe up the Planes GE, KL MN, RO, perpendicular to the Planes HE, PN, and draw Threads, or imagine Lines drawn thro' GK, FB, MR, XD, and thro' T, V, parallel to the two latter, and ſo will the ſolid Figures be repreſented to the Eye.

PROP. XXXIV. the latter Part. Raiſe the Planes GH, GV, till GK in the former coincides with GK in the latter; and FY, FL, till BF coincides with BF: Alſo MP, MΩ, till RM coincides with RM; and XO, XΦ, till DX coincides with DX; and draw Threads, or ſuppoſe Lines drawn thro' GF, KB, MX, RD, and the ſolid Figures will be repreſented to View.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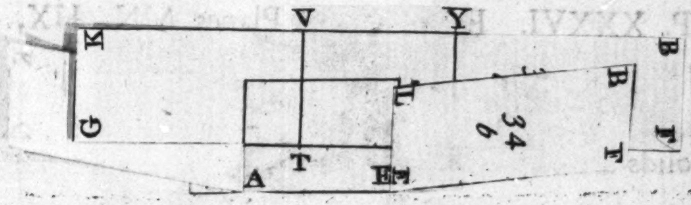
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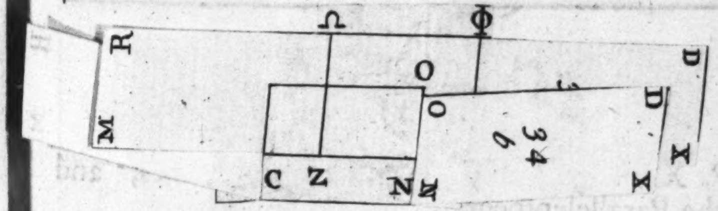
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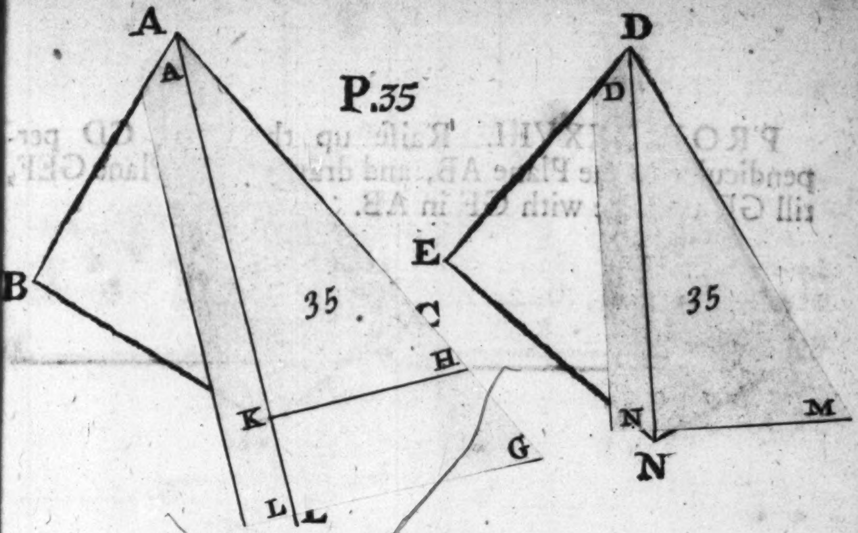
PROP. XXXV. Raiſe the Planes AGL, DMN, perpendicular to the Planes ABC, DEF, and draw Threads, or conceive Lines drawn thro' HB, HC, ME, MF, and you have the ſolid Figures.

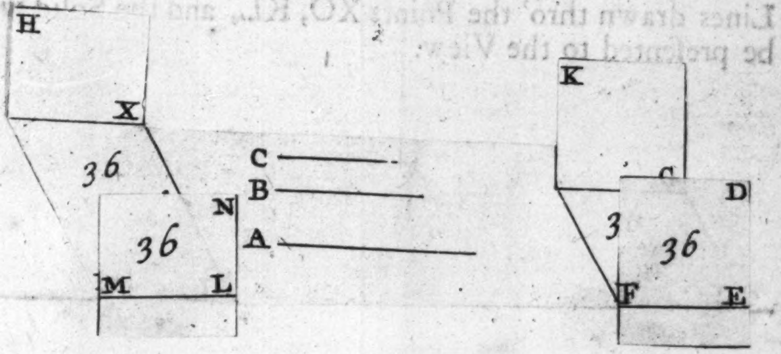
PROP. XXXVI. Raiſe up the Planes MN, HX, FD, RG, till they make equal Inclinations to the Plane MG, and draw Threads, or ſuppoſe Lines drawn thro' the Points H, N, K, D, to compleat the Parallelepipedons, and the Solids are expoſed to the Eye.

PROP. XXXVII. Raiſe up the eight Planes, and compleat the Parallelepipedons.

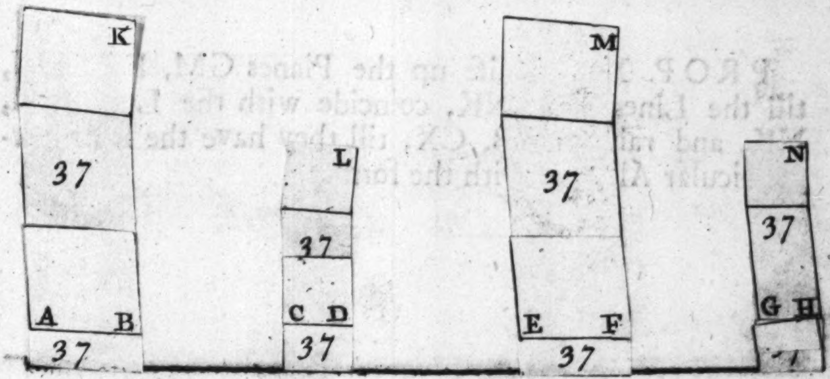


PROP. [illegible] Raiſe up th[illegible] CD perpendicu[illegible] e Plane AB, and dra[illegible] Plane GEF, till G[illegible] with GF in AB.

PROP. XXXIX. Raiſe up the Planes AD, GF, AE, BF, till the Lines AC, BD, EG, FH, coincides with the Lines AC, BD, EG, FH, and draw Threads, or conceive Lines drawn thro' the Points XO, KL, and the Solid will be preſented to the View.



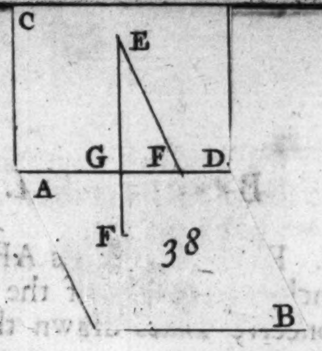
PROP. [illegible] Raiſe up the Planes GM, [illegible] till the Lines [illegible] KL, coincide with the L[illegible] [illegible] and raiſe [illegible] CX, till they have the [illegible] [illegible]icular AB, [illegible] with the ſame.



PROP. XXXVIII. Raiſe up the Plane CD perpendicular to the Plane AB, and draw out the Plane GEF, till GF coincide with GF in AB.

PROP. XXXIX. Raiſe up the Planes AD, GF, AE, BF, till the Lines AC, BD, EG, FH, coincides with the Lines AC, BD, EG, FH, and draw Threads, or conceive Lines drawn thro' the Points XO, KL, and the Solid will be preſented to the View.

PROP. XL. Raiſe up the Planes GM, KO, HN, till the Lines MH, NK, coincide with the Lines MH, NK, and raiſe up EB, CX, till they have the ſame perpendicular Altitude with the former.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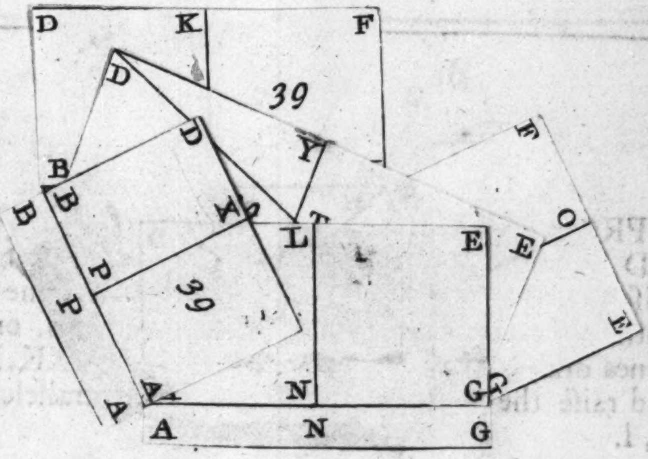
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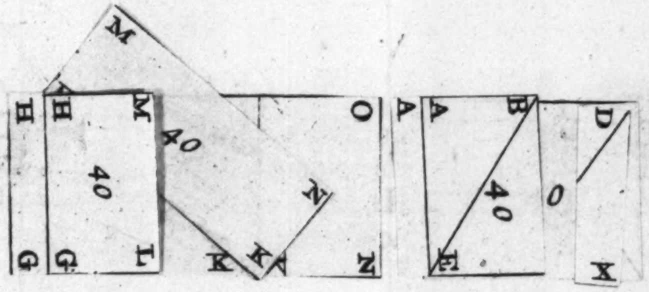
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BOOK XII.

PROP. III. Raiſe the Planes ABD, ACD, till AD of the one coincides with AD of the other, and draw a Thread, or conceive Lines drawn thro' the Points EF, GF, EG.

PROP. IV, V. Raiſe up the Planes HDE, HDF, till HD of the one coincides with HD of the other; and raiſe the Planes GAB, GAC, till GA of the one coincide with GA of the other; and draw Threads, or ſuppoſe Lines drawn thro' the Points QP, QR, PR, XK, XL, KL, and raiſe the Planes, and compleat the Parallelepipedons Z, I.

PROP. VI. Raiſe up the Planes AME, EMD, DMC, till the Points M, M, M, coincide, and conceive drawn the Line MB. Alſo raiſe FNL, LNK, KNH, till the Points N, N, N, coincide, and conceive the Line NG drawn.

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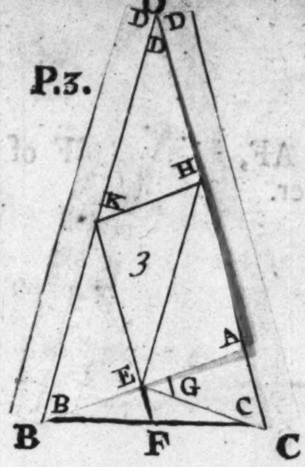
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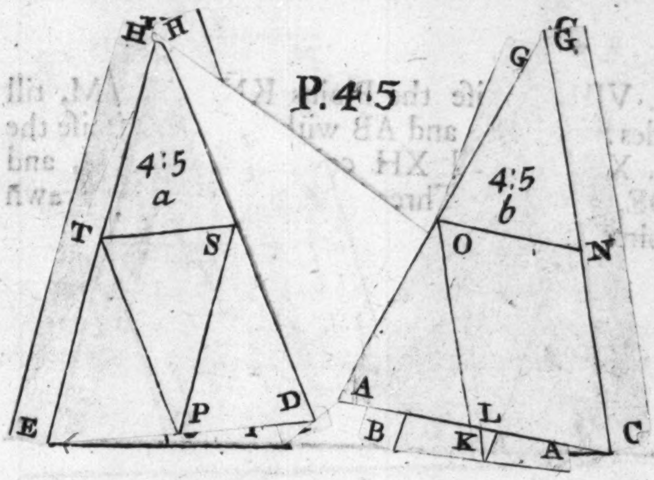
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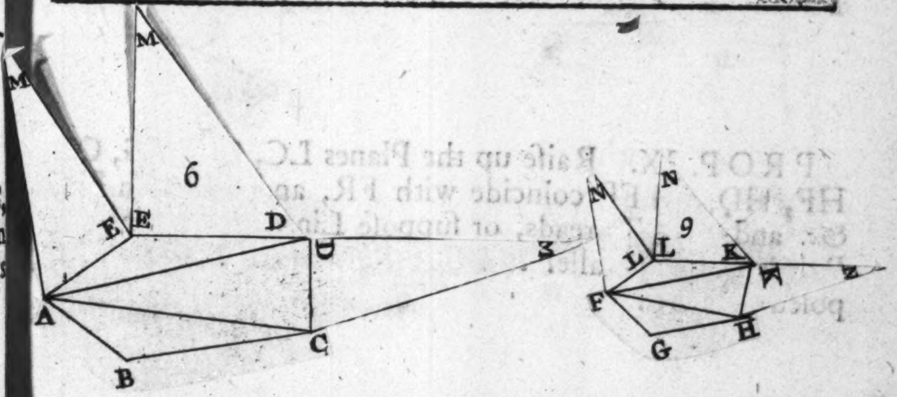
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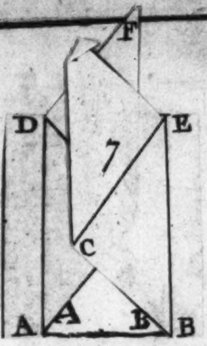
PROP. VII. Raiſe the Planes AF, BF, till CF of the one coincide with CF of the other.

PROP. VIII. Raiſe the Plains KN, KB, BM, till GK coincides with GK, and AB with AB; and raiſe the Planes XR, XE, EP, till XH coincides with XH, and DE with DE, and draw Threads, or ſuppoſe Lines drawn thro' the Points LM, OP.

PROP. IX. Raiſe up the Planes LC, GC, AG, OF, HF, HD, till FR coincide with FR, and HE with HE, *&c.* and draw Threads, or ſuppoſe Lines drawn thro' the Points L, O, parallel to BC, HR, and the Solids are expoſed to View.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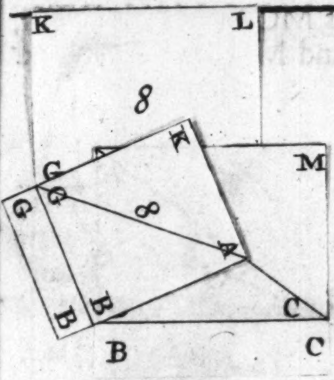
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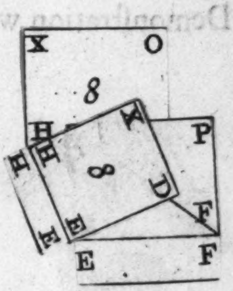
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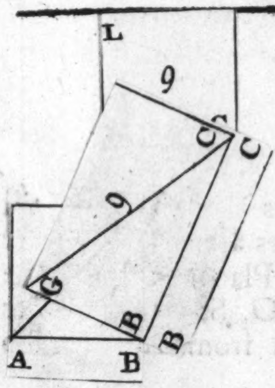
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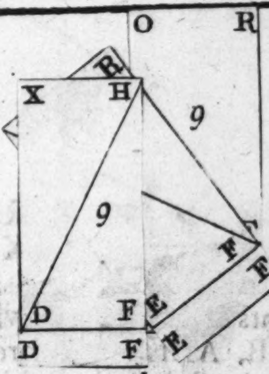
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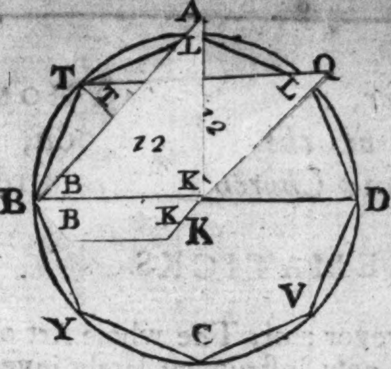
PROP. XII. Raiſe the Planes MON, MFN, KTL, KBL, till KL coincide with KL; and MN with MN, and the Demonſtration will be plain.

PROP. XVII. Raiſe the Planes AXB, AXK, till AX coincides with AX, and the Planes are perpendicular to the Plane CBM; and raiſe the Plane OK, till the Points O, S coincide with the Points O, S, on the Planes AXB, AXK, and ſtretch a Thread from A to Z, ſo will the Sphere be exhibited to View.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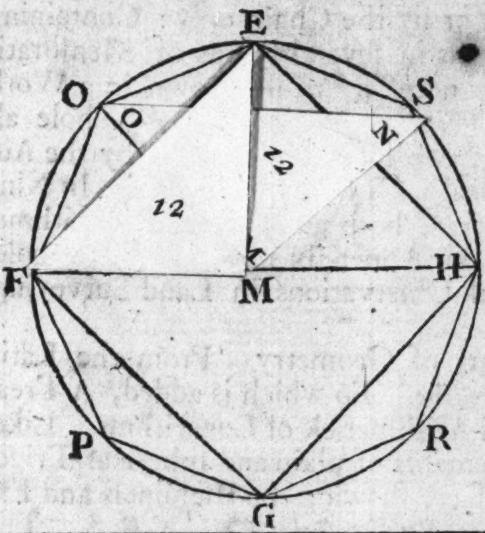
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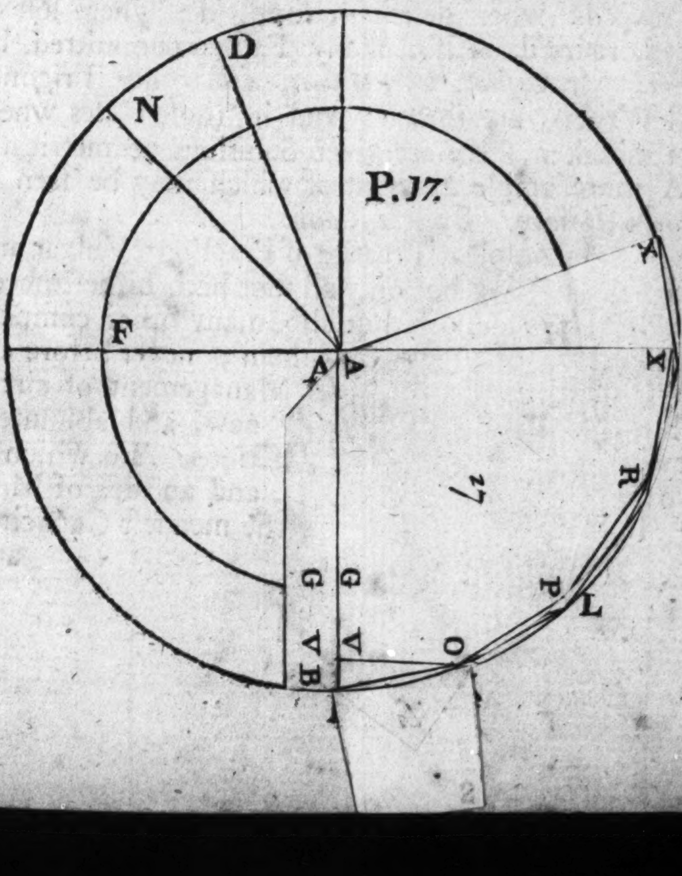
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